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THE WEST AMERICAN HALIOTIS

By Paul Bartsch

Several interesting sendings of sea-ears from California by A. Sorensen made it necessary to subject the West American members of the genus *Haliotis* to a critical examination. The results are noted below. I am deeply indebted to Mr. Sorensen for the fine specimens sent us, which not only materially expand our series of the developmental stages of some species but also add several new forms to the Californian faunal area. To Prof. H. H. Plough and the authorities of Amherst College I am greatly obliged for the privilege of examining and figuring the type of *Haliotis ponderosa* C. B. Adams, which I am here reestablishing as a good species.

Mr. Sorensen has also given me some interesting notes on the color of *Haliotis* animals from which I quote: "Those with black bodies are: *Haliotis rufescens* Swainson and *H. cracherodii* Leach and its varieties. Those with yellowish and dark spotted bodies are: *Haliotis assimilis* Dall, *H. kamtschatkana* Jonas, *H. walallensis* Stearns, *H. fulgens* Philippi, *H. corrugatus* Gray, and *Haliotis*, new species" (*Haliotis sorenseni*, described herein.) He also states: "I am quite well acquainted with the California coast, since 1885 continuously, and with the abalone industry. The largest catch comes into Monterey, the second to Morro Bay, and a few to Avila. There is no regular commercial abalone fishing south of Avila, but occasionally some of the boats go south to Santa Barbara, and what catch they make there and up to Point Conception is sent by truck to Monterey." These are facts of importance to students of abalones as well as to the men commercially interested in the group.

Genus HALIOTIS Linnaeus

HALIOTIS SORENSENI, new species

PLATE 6

Shell large, thin, the exterior brownish red, decidedly inflated, spire well elevated. Between the line of strongly elevated craterlike siphonal perforations, of which the last four or five are open, and the edge of the shell the upper three-fourths is gently rounded, while the outer quarter flares to a considerable expansion, which produces a decided, concave line at the inner edge of the outer fourth of this part of the shell. The outer surface is marked by more or less regular, broad, low, axial ridges, which bear irregularly developed, not strongly pronounced, nodules. The outside is further provided with numerous closely placed, slender, spiral cords that vary materially in strength and with numerous closely spaced, incremental lines that almost equal the spiral cords in strength. In addition to this sculpture, broad, low, elevated, axial areas, which are feebly nodulose, alternate with depressed zones. The interior of the shell is iridescent with a pinkish pearly hue prevailing, and bright rosy tints mark the outer half, while within, scattered greenish areas of irregular size and distribution are present. The muscle scar, usually strongly marked in *Haliotis*, is here but feebly impressed, in which character it resembles the other Californian deep-water species, *Haliotis assimilis*. It resembles that form also in the excavated inward sloping of the expanded dextral margin of the aperture and the sealing-wax-colored edging of the peristome, but differs materially in size and in the color of the interior.

The type, U.S.N.M. No. 535688, resting upon the aperture, yields the following measurements: Greater length, 218 mm.; greater diameter, 168 mm.; height, 81 mm. It weighs 448 grams.

Two paratypes in Mr. Sorensen's collection yield the following measurements, respectively: Greater length, 200, 210 mm.; greater diameter, 149, 172 mm.; greater height, 79, 65 mm.; weight, 370, 465 grams. Of these specimens Mr. Sorensen writes: "They were found slightly south of Point Conception, Calif., by a commercial abalone diver, in 10 fathoms depth. After one was found, diligent search for 2 weeks succeeded in finding only three more. No other diver found any; the time was about September 15, 1939." A subsequent letter states: "The animal was colored yellowish with dark specks, and the meat was quite tender."

Recently, on his way to Mexico, Mr. Sorensen found a curio dealer near San Diego who had secured a number of what he called the pink abalone from a man who had brought Mexican shells north to him.

Mr. Sorensen has sent two of these to me, and I find that they agree in every way with the type but are somewhat smaller. Their measurements are, respectively, as follows: Height, 63, 51 mm.; greater diameter, 165, 156 mm.; lesser diameter, 132, 123 mm. The dealer stated that they were very rare, and he believed that they originated from some of the islands offshore, probably Guadalupe; we therefore have an additional station, which materially extends the known range of the species.

HALIOTIS ASSIMILIS Dall

1878. *Haliotis assimilis* Dall, Proc. U. S. Nat. Mus., vol. 1, p. 46.

This strongly inflated, oval species we had in the collection of the National Museum from the region of San Pedro and San Diego, where it was said to occupy rather deep water. Mr. Sorensen's sending has extended its known range as far northward as Monterey County.

HALIOTIS RUFESCENS Swainson

This species extends from Mendocino County, Calif., to the offlying islands to the south. The typical race is an important element in the West American abalone fisheries.

I am recognizing three subspecies, as follows:

HALIOTIS RUFESCENS RUFESCENS Swainson

1822. *Haliotis rufescens* Swainson, Appendix to the Bligh Catalogue, Exotic conchology, ed. 2, p. 34.
1832. *Haliotis californiana* Valenciennes, Recueil d'observations de Zoologie . . . Voyage Humboldt et Bonpland, vol. 2, p. 267.

This gigantic race ranges from Mendocino County, Calif., south to Catalina Island.

The two largest specimens in our collection, U.S.N.M. No. 535758, donated by Mr. Sorensen, yield the following measurements, respectively: Height, 87, 76 mm.; greater diameter, 251, 257 mm.; lesser diameter, 213, 218 mm.; weight, 1,528, 1,062 grams.

HALIOTIS RUFESCENS WALALLENSIS Stearns

1900. *Haliotis fulgens walallensis* Stearns, Proc. U. S. Nat. Mus., vol. 22, p. 140.
1921. *Haliotis wallalensis* Dall, U. S. Nat. Mus. Bull. 112, pl. 22.

This small northern race was described by Dr. Stearns from Gualala, Mendocino County, Calif. Its narrower shape, less rugose surface, and smaller size differentiate it from the typical race.

HALIOTIS RUFESCENS HATTORII, new subspecies

PLATE 8, FIGURES 4–6

Shell small, oval, rather flat, spire depressed, with a slight auricle where the outer lip joins the preceding whorl at the summit. The color of the first half of the shell is blue, slightly variegated with red. The last half is banded with zones of red and bluish white. The sculpture consists of irregular lines of growth and indications of axial waving. The spiral sculpture consists of low, flattened threads, which are not quite so wide as the spaces that separate them. These, in combination with the incremental lines, give the surface a somewhat clothlike texture. The siphonal angle bears moderately elevated craters, the last four of which are open. Between this siphonal line and the edge of the aperture the shell is rounded and marked like the surface posterior to the siphonal line. The entire outer surface has a waxy appearance. The interior is pearl-gray with iridescent tints, the outer edge of the outer lip being pale reddish. The right edge of the aperture is slightly crenulated; the left edge is rather broadly expanded and flattened, sloping outward, the shelf being about the same width on the parietal wall. Muscle scar poorly differentiated.

The type, U.S.N.M. No. 535761, was collected by Mr. Hattori, an abalone diver, near Santa Barbara, for whom I take pleasure in naming the form. When placed on the aperture it yields the following measurements: Height, 18 mm.; greater diameter, 100 mm.; lesser diameter, 74 mm.

This subspecies can be differentiated easily from typical *Haliotis rufescens rufescens* by its very flat shape, the very poorly elevated spiral threads, the waxy surface, and by lacking the elevated tumid area between the siphonal line and the edge of the aperture. From *H. rufescens walallensis* it is easily distinguished by its much broader shape and feebler sculpture.

HALIOTIS PONDEROSA C. B. Adams

PLATE 7

1848. *Haliotis ponderosa* C. B. ADAMS, Amer. Journ. Sci. and Arts, ser. 2, vol. 6, pp. 138–139.

Shell large, very heavy, strongly inflated, spire well elevated. The exterior is brownish red, rough, and somewhat worn. It shows irregularly developed and distributed, weakly irregularly nodulose axial ridges and very rough incremental lines, as well as indications of spiral cords. Anterior to the line of siphonal craters, the last four of which are open, the shell is moderately elevated and strongly rounded. On the early part of the last turn it has a broad, feebly

developed, median tumid ridge. The dextral and parietal walls of the aperture are broadly expanded, sloping slightly inward, but not excavated. Interior iridescent with pearly gray tint prevailing. Muscle scar large, rugose-granulose.

The type, deposited at Amherst College, yields the following measurements: Greater length, 215 mm.; greater diameter, 167 mm.; height, 80 mm.; weight, 965 grams.

The shell appears nearest related to *Haliotis rufescens*, from which the ponderous shell, well-elevated spire, and pale interior (*H. rufescens* has the lively iridescent-green color scheme) readily differentiate it.

It is to be regretted that Professor Adams was unable to give any information about the habitat of this abalone. I believe that it should be looked for in southern California on extremely exposed and surf-beaten ledges.

HALIOTIS FULGENS Philippi

1845. *Haliotis fulgens* Philippi, Zeitschr. für Malak., vol. 2, p. 150.
1846. *Haliotis splendens* Reeve, Conchologia iconica, fig. 9.
1846. *Haliotis planilirata* Reeve, Conchologia iconica, fig. 62.

This species possesses remarkably uniform characters. We have it in the United States National Museum collection from San Diego to Cape San Lucas, from Catalina, Santa Rosa, Guadalupe, San Bonita, and Cerros Islands, and a young specimen from La Paz, within the Gulf.

HALIOTIS AULAEA, new species

Plate 8, Figures 1–3

Shell of medium size and rather low, spire slightly elevated. The color scheme of the exterior is a mixture of green and red, more or less disposed in interrupted spiral zones, producing a tapestry-like effect. Interior pearl-gray, edge of peristome variegated chiefly with green. The exterior is marked by numerous flattened spiral cords, which vary materially in size, usually finer ones separating the broad elements. In addition there are obliquely protractively, radiating nodulose ridges, the nodules being depressed. The surface likewise has numerous incremental threads, which render the finer cords minutely nodulose and the rest lirate. The siphonal angle bears numerous craterlike projections, the last six of which are open. Anterior to the siphonal angle there is a rather strong spiral cord midway between this ridge and the basal edge of the shell. This part of the shell is also marked by spiral cords, a little finer than those on the spire, and by the continuation of the incremental elements. The aperture is broadly oval, the outer edge of the peristome is acute,

while the posterior portion of the inner lip slopes materially inward. The surface of the inside is wavy and its color pearl-gray.

The type, U.S.N.M. No. 535848, was collected by A. Sorensen in 8 to 10 fathoms off Cayucas, Calif. It measures: Height, 34 mm.; greater diameter, 110 mm.; lesser diameter, 85 mm.

U.S.N.M. No. 535849 contains four additional specimens, which range from a length of 53 mm. to almost the size of the type. These came from 10 to 15 fathoms off the southern part of Monterey County, Calif. Two others, U.S.N.M. No. 535850, came from off Port San Luis Obispo, Calif.

This species suggests slightly *Haliotis kamtschatkana* but is much broader than that. It reminds one also of *H. assimilis*, but its coarse sculpture at once removes it from that association.

HALIOTIS KAMTSCHATKANA Jonas

1845. *Haliotis kamtschatkana* Jonas, Zeitschr. für Malak., vol. 2, p. 168.

This narrow, rough species, with spire highly elevated, is represented in our collection by specimens taken at points ranging from Alaska south to Monterey Bay.

HALIOTIS SMITHSONI, new species

Plate 8, Figures 7–9

Shell large, with a strongly mammillated spire, whose whorls are separated by a rather deeply impressed suture. From the summit to the row of siphonal apertures the whorls are almost straight, a little convex on the last portion of the last turn. The siphonal openings are craterlike, the last three or four being open. The sculpture between the summit of the whorl and the siphonal line consists of coarse incremental lines that develop into inconspicuous, low, rounded ridges, which are almost regular in distribution; these ridges bear obsolete, ill-defined nodules. In addition there are slender spiral threads, which are of varying width and differ slightly in spacing. Between the siphonal line and the edge of the aperture there is a low, raised keel a little posterior to the median line. The space between this rounded keel and the siphonal line is slightly concave and marked by incremental lines and spiral threads. Anterior to this submedian line the shell is slightly rounded and marked by the continuation of the rugose radial threads referred to for the spire and spiral threads. The aperture is oval and is sharp on the dextral margin, while the left margin is moderately broad and slopingly excavated. This slope extends over the parietal wall, where it is a little broader. The muscle scar is rather pronounced. The color

scheme of the interior is pearly gray with iridescent, prismatic, scattered flashes.

The type, U.S.N.M. No. 60425, comes from Catalina Island. Placed flat on the aperture it measures: Height, 57 mm.; greater diameter, 140 mm.; lesser diameter, 107 mm.

There are two additional specimens in our collection, one of which, a little smaller than the type, U.S.N.M. No. 98329, collected by Dr. Cooper at Santa Cruz Island, measures: Height, 50 mm,; greater diameter, 119 mm.; lesser diameter, 94 mm. The other, U.S.N.M. No. 11868, a very large specimen, bears the locality label San Diego, which I somewhat question. This measures: Height, 77 mm.; greater diameter, 193 mm.; lesser diameter, 148 mm.

This species suggests *Haliotis kamtschatkana.* Its gigantic size and comparatively feebler sculpture will readily distinguish it from that. I take pleasure in naming it for the founder of the Smithsonian Institution, James Smithson.

HALIOTIS DALLI Henderson

1915. *Haliotis* (*Padollus*) *dalli* HENDERSON, Proc. U. S. Nat. Mus., vol. 48, p. 661, pls. 45, 46 (lower figures).

This small species of *Haliotis* was dredged by the United States Bureau of Fisheries steamer *Albatross* in 33 fathoms near Charles Island, Galapagos.

HALIOTIS CRACHERODII Leach

This species ranges from San Francisco to San Quentin Bay, along the mainland; in other words, through the major portion of the Californian faunal area, stretching, however, over part of the Oregonian area to the north. It extends also over the off-lying islands.

Haliotis californiensis Swainson must be relegated to the rank of subspecies, for the organisms on Cerros and San Bonita Islands form perfect intergrades between the typical *H. cracherodii* and *H. californiensis.* Two subspecies, therefore, will be recognized.

HALIOTIS CRACHERODII CRACHERODII Leach

1817. *Haliotis cracherodii* LEACH, Zool. Misc., vol. 1, p. 31, pl. 58.
1892. *Haliotis cracherodii splendidula* WILLIAMSON, Proc. U. S. Nat. Mus., vol. 15, p. 198.
1900. *Haliotis rosea* ORCUTT, West Amer. Sci., vol. 10, p. 30.
1900. *Haliotis corrugata diegoensis* ORCUTT, West Amer. Sci., vol. 10, p. 31.
1907. *Haliotis cracherodii holzneri* HEMPHILL, Trans. San Diego Soc. Nat. Hist., vol. 1, p. 59.
1919. *Haliotis cracherodii imperforata* DALL, Proc. U. S. Nat. Mus., vol. 56, p. 370.
1921. *Haliotis cracherodii holzneri* DALL, U. S. Nat. Mus. Bull. 112, pl. 20.
1921. *Haliotis cracherodii imperforata* DALL, U. S. Nat. Mus., Bull. 112, pl. 21.

This subspecies differs from *Haliotis c. californiensis* in having the perforations much larger and more distantly spaced, and consequently much less numerous.

The other named shells placed in the synonymy of this subspecies above I believe represent individual variations, not isolated geographic races, which if they must be referred to by name had best be designated "forms" rather than "subspecies."

This subspecies embraces all *Haliotis cracherodii* except those from Guadalupe Island:

HALIOTIS CRACHERODII SPLENDIDULA Williamson:

Mrs. Williamson stated under the above designation that a number of shells found at one time at Point Vincent, Calif., have brilliant blotches of color in their interior, somewhat like *H. fulgens* Philippi, and some have spots of brown.

HALIOTIS CRACHERODII HOLZNERI Hemphill:

The specimen figured by Dr. Dall, U.S.N.M. No. 199890, is a distorted, decidedly twisted, individual having perforations. Hemphill's description calls for an absence of perforation, in which respect *Haliotis cracherodii holzneri* would agree with *Haliotis imperforata* Dall.

HALIOTIS CRACHERODII IMPERFORATA Dall:

Under this Dr. Dall says: "In the Nautilus for December, 1910 (p. 96), I described a unique form of this species which is entirely imperforate, never having had any perforations, but appears normal in every other respect. While this can hardly be termed a variety it seems well to give it a name in order that it may be kept in mind by those interested in teratology of mollusca. The specimen is U. S. Nat. Mus. Cat. No. 219850, and measures 100 mm. in length by 42 in height and 95 in width, and was collected on the coast of California not far from San Pedro."

HALIOTIS ROSEA Orcutt:

Orcutt distinguished this from the typical form on account of its "rich, extremely beautiful, reddish epidermis."

HALIOTIS CORRUGATA DIEGOENSIS Orcutt:

The type of Mr. Orcutt's subspecies is in the collection of the U. S. National Museum (No. 162007) and is plainly a large, decidedly worm-eaten, senescent *Haliotis cracherodii.*

HALIOTIS CRACHERODII CALIFORNIENSIS Swainson

1823. *Haliotis californiensis* SWAINSON, Zool. Illus., ser. 1, vol. 2, pl. 80.
1900. *Haliotis bonita* ORCUTT, West Amer. Sci., vol. 10, p. 30.

This is the subspecies with the small and numerous perforations. Our large series of specimens from Guadalupe Island agree perfectly with Swainson's figures, and they are the only ones that absolutely satisfy them. I therefore believe that the type locality for *H. californiensis* is Guadalupe.

The type of Orcutt's *Haliotis bonita*, U.S.N.M. No. 162008, bears on its label "near Santa Barbara, California," but in his description he adds, after citing Santa Barbara, "It is evidently rare and may be from Mexican waters."

I agree with this last statement for it undoubtedly came from Guadalupe Island.

In addition to the living species referred to above, the following fossil *Haliotis* have been described from California:

HALIOTIS LOMAËNSIS F. M. Anderson

1902. *Haliotis lomaënsis* F. M. ANDERSON, Proc. California Acad. Sci., ser. 3, Geology, vol. 2, p. 75, pl. 9, fig. 183.

Dr. Anderson described a specimen from the Cretaceous of the lower Chico bed of San Diego County, Calif.

The type is No. 65 of the California Academy of Sciences Invertebrate Paleontological collection.

HALIOTIS PALEA Woodring

1931. *Haliotis palea* WOODRING, Journ. Pal., vol. 50, pp. 38, 39, pl. 6, figs. 1–3.

This species comes from the Miocene of the south slope of Santa Monica Mountains, south end of the ridge along the east side of Brown Canyon, Los Angeles, Calif.

The type is No. 1206 in the California Institute of Technology.

Dr. Woodring considers this related to *Haliotis corrugata* Gray, with which I agree.

HALIOTIS LASIA Woodring

1932. *Haliotis lasia* WOODRING, Proc. U. S. Nat. Mus., vol. 81, pp. 1–4, pl. 1.

This species was described by Dr. Woodring from the Miocene of Temblor Range, San Luis Obispo County, Calif.

The type, U.S.N.M. No. 371767, and 19 paratypes, U.S.N.M. No. 371768, are listed.

Dr. Woodring considers this most nearly related to *Haliotis fulgens* Philippi.

HALIOTIS ELSMERENSIS Vokes

1935. *Haliotis elsmerensis* VOKES, Journ. Pal., vol. 9, pp. 251–252, pl. 25, figs. 22, 23.

This species was described by Dr. Vokes from the Pliocene of Elsmere Canyon, Los Angeles County, Calif. He says it is related to *H. rufescens* Swainson.

The type is No. 32465 of the University of California Museum of Invertebrate Paleontology.

HALIOTIS KOTICKI Hertlein

1937. *Haliotis koticki* HERTLEIN, Bull. Southern California Acad. Sci., vol. 36, pp. 94–96, pl. 42, figs. 1, 2.

This species comes from the lower Miocene west of Zaca Peak, central part of Lompoc Quadrangle, Santa Barbara County, Calif.

The type is No. 286 in the California Academy of Sciences Invertebrate Paleontological collection.

Hertlein considers this related to *H. corrugata* and *H. kamtschatkana* Jonas.

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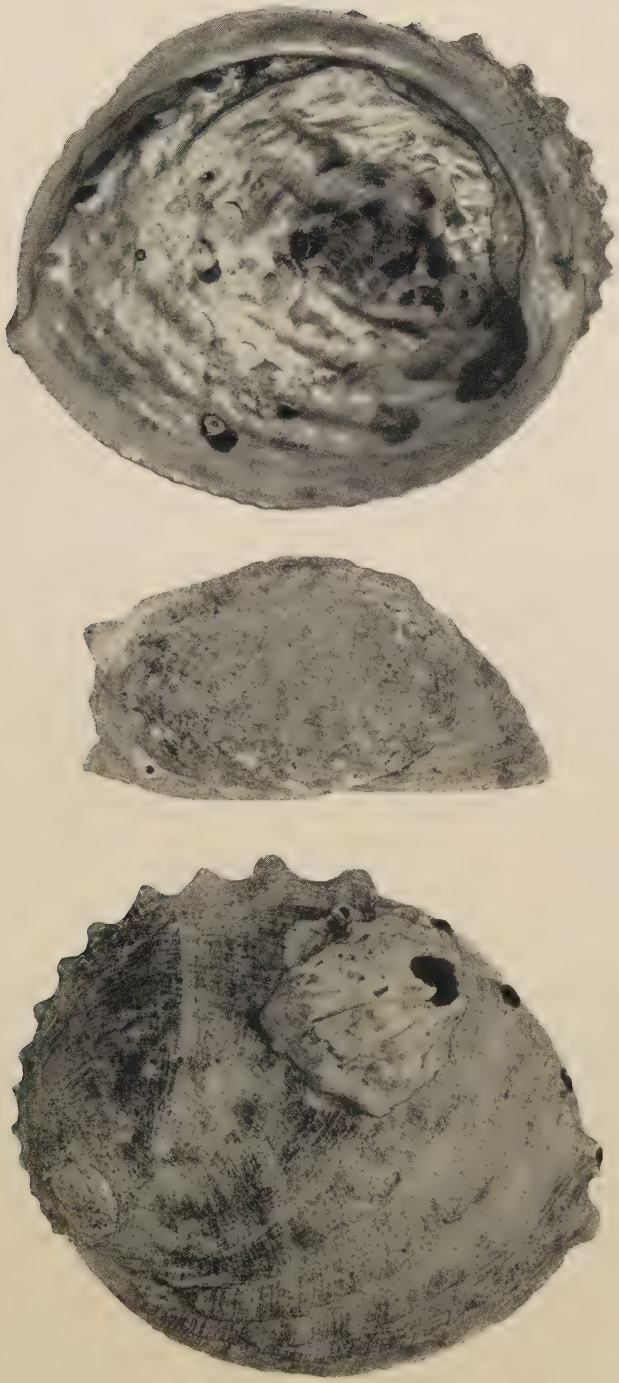
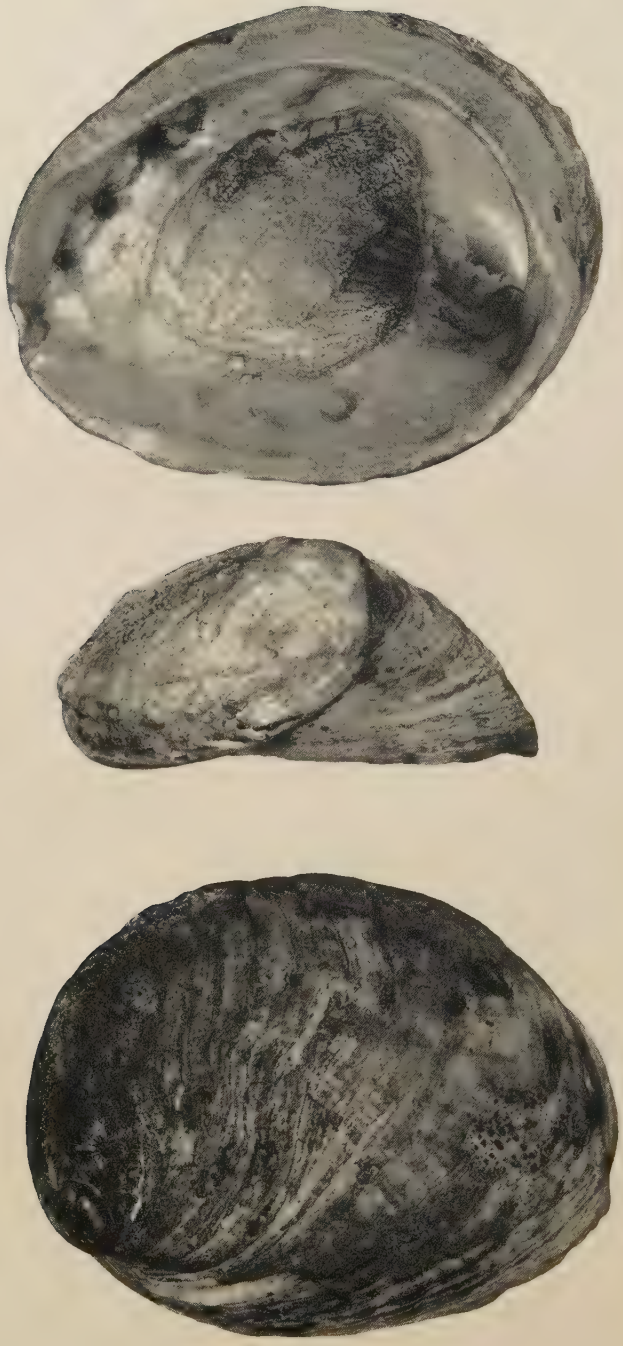
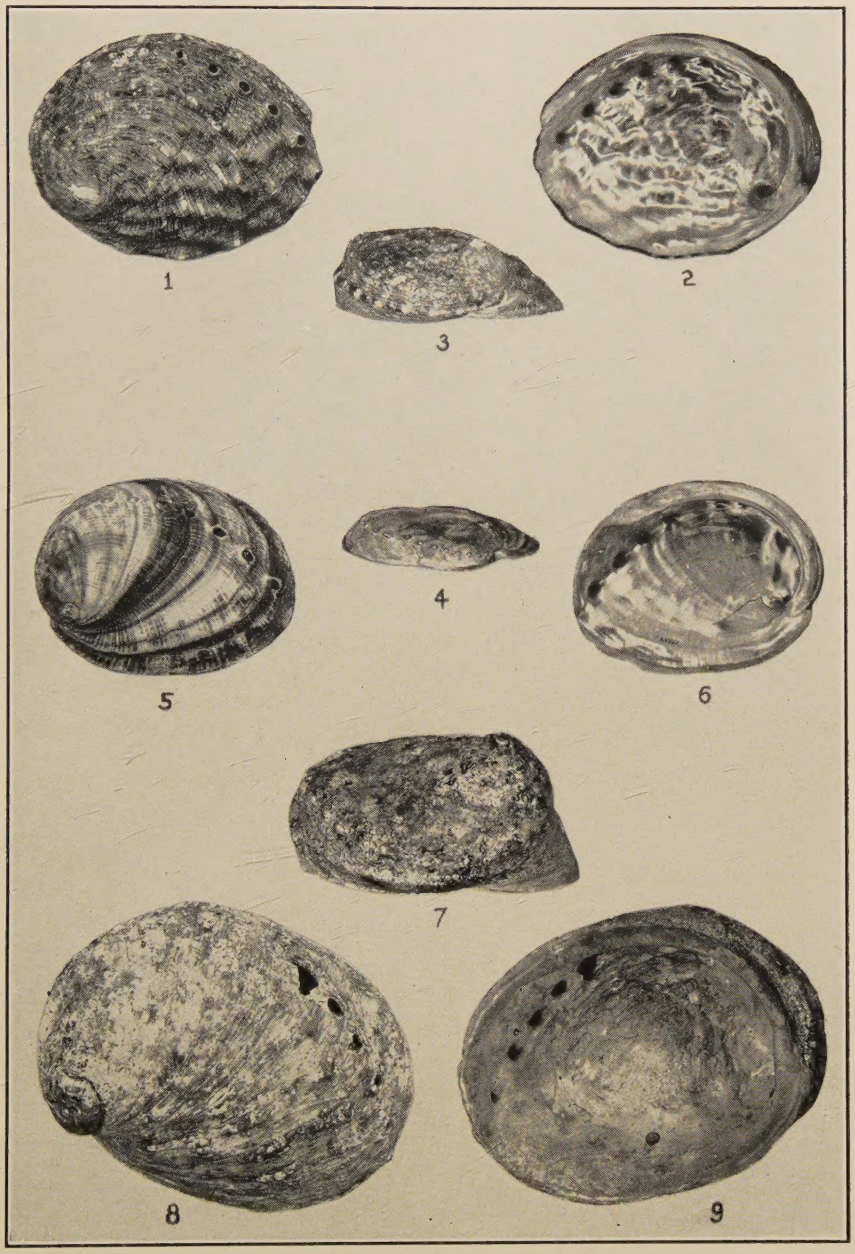


HALIOTIS SORENSENI, NEW SPECIES.



HALIOTIS PONDEROSA C. B. ADAMS.



NEW SPECIES AND SUBSPECIES OF HALIOTIS.

1–3, *H. aulaea;* 4–6, *H. rufescens hattorii;* 7–9, *H. smithsoni.*